PATENT SPECIFICATION

769,368

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COMPLETE SPECIFICATION

Improvements in Hot Gas Reciprocating Engines.

We, JAMES WINDRUM, a British subject, of 1 Stow Street, Paisley, Renfrewshire, Scotland, and THE SPENCER WIRE COMPANY LIMITED, a British Company, of Thornes Wire Mills, Wakefield, England, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention has reference to hot gas reciprocating engines and has for its object to provide an improved engine which will have a high thermal efficiency.

According to the present invention a hot gas reciprocating engine is provided with means for supplying motive fluid alternately to each side of a piston working within a cylinder such means comprising a pair of chambers connected respectively one to one end of the cylinder and the other to the other end thereof, means to introduce a charge of a liquid to each chamber, means to gasify such liquid and to heat the gas so generated, a gas displacer in each chamber reciprocated in timed relationship with the piston and by which the heated gas is displaced from the chambers to act alternately on opposite sides of the piston and means to cool the gas prior to the gas acting on the piston to perform the working stroke and to cool but not condense the gas after it has performed the working stroke, the cooled gases returned to the said chambers being displaced by the gas displacers therein so that they are brought into contact with the heaters by which they are again heated to repeat the aforesaid cycle of operations, the engine being thus operated by the sensible heat which has been supplied to the gasified liquid by the heating means.

One embodiment of heat engine will now be described with reference to the annexed drawings wherein:

Fig. 1 is an elevation of a hot gas reciprocating engine formed of a pair of reciprocating engines in accordance with the invention the working cylinders being shown in section;

Fig. 2 is an end elevation thereof;

Fig. 3 is a plan view thereof; and

Fig. 4 is a diagrammatic view showing the cycle of operations.

The improved engine as shown in the drawings embodies two working cylinders a and a^1 in which are double acting pistons b and b^1 connected by means of their piston rods and connecting rods to a crank shaft c in known manner. The crank shaft is mounted in suitable bearings d and has fast thereon a flywheel e.

Associated with the cylinder a are two cylindrical chambers f and g and associated with cylinder a^1 are two cylindrical chambers f^1 and g^1.

Cylinder a is connected at its upper end by means of a conduit h to the upper end of the chamber f and is connected at its lower end by conduit i to the upper end of chamber g. Likewise cylinder a^1 is connected by means of a conduit h^1 to the upper end of the chamber f^1 and is connected at its lower end by conduit i^1 to the upper end of chamber g^1.

In each of the four chambers f, g, f^1 and g^1 there are gas displacers by which gases in the foot thereof are displaced to the top thereof and vice versa. In the engine shown in the drawings each of such gas displacers is in the form of a cylinder k closed at the top and bottom and forming with its enclosing cylindrical chamber a substantial annular clearance for the passage of gases therethrough.

The gas displacers are reciprocated in timed relationship with the pistons b, b^1 and in the arrangement illustrated this is effected by driving a pair of overhead shafts l and l^1 through chain and sprocket drive m and m^1 from the crank shaft c.

or the like n and o and shaft l^1 with similar transmission means n^1 and o^1, the eccentrics, cranks or the like being operatively connected to the gas displacers.

It will be seen from Fig. 4 that the crank to which piston b is connected is set 90° in advance of the crank to which piston b^1 is connected.

Further it will be noted from the same figure that when piston b is in its mid position the gas displacers in chambers f and g are in their top and bottom position respectively. Also when the piston b^1 is at the top of its stroke the displacers in chambers f^1 and g^1 are in their mid position.

Each of the chambers f, g, f^1 and g^1 is provided with means whereby the gases in the foot thereof are heated. This may take the form of an electric heater p.

The cylinders a and a^1 are surrounded by a jacket or tank q, the chambers f and f^1 at their upper ends are surrounded by a jacket or tank r and the chambers g and g^1 are enclosed at their upper ends by a jacket or tank s. Water or other liquid cooling medium is introduced into the said jackets or tanks.

The motive fluid for the engine is in the form of gases formed by vaporising a volatilizable liquid such as, for example, methylated spirit, a small quantity of which is introduced into the four chambers f, f^1, g, and g^1 through suitable means. The liquid in each chamber is vaporised by the heaters and sufficient heat is imparted thereto to raise the pressure of the gases to an appreciable extent sufficient to supply the working cylinders with the necessary motive fluid.

Referring to Fig. 4, the gases in chamber f have been expelled from the upper end thereof and have been passed to the cylinder a to act on the piston therein. The piston is thereby forced downwards to rotate the crank shaft. The gases on the underside of the piston which have cooled by reason of their expansion pass to the top of chamber g and are then displaced by the piston k therein so that they pass to the underside thereof as said piston rises. The gases transferred to the foot of chamber g are heated and are then displaced to the top of the chamber and from there transferred to act on the underside of the piston b, the latter being then at the foot of its stroke. The piston b then performs its upward working stroke, the gases in the top of cylinder a being transferred to the top of chamber f, and then displaced to the foot thereof where they are heated prior to being returned to likewise reciprocated by gases heated in chambers f^1 and g^1, the gases after effecting a working stroke returning to the said chambers to be reheated.

It is found advantageous to surround the working cylinders and the upper ends of the chambers f, g, f^1 and g^1 with cooling medium contained in the enclosing tanks.

Sufficient latent heat must, of course, be imparted to vaporise the methylated spirits and the like in starting the engine but thereafter the gases are never allowed to condense. Consequently the latent heat is not extracted from the gases until the engine is stopped. The gases are heated just to that extent which is necessary to ensure that they will be delivered to the working cylinders at the desired pressure. When they have performed their useful work the gases, which have now expanded and are cooling, are re-heated so as to ensure that they will be fed to the working cylinders at the desired pressure. That is the temperature of the gases fluctuates within defined limits exceeding the temperature at which they will condense.

What we claim is:

1. A hot gas reciprocating engine provided with means for supplying motive fluid alternately to each side of a piston working within a cylinder such means comprising a pair of chambers connected respectively one to one end of the cylinder and the other to the other end thereof, means to introduce a charge of a liquid to each chamber, means to gasify such liquid and to heat the gas so generated, a gas displacer in each chamber reciprocated in timed relationship with the piston and by which the heated gas is displaced from the chambers to act alternately on opposite sides of the piston and means to cool the gas prior to the gas acting on the piston to perform the working stroke and to cool but not condense the gas after it has performed the working stroke, the cooled gases returned to the said chambers being displaced by the gas displacers therein so that they are brought into contact with the heaters by which they are again heated to repeat the aforesaid cycle of operations, the engine being thus operated by the sensible heat which has been supplied to the gasified liquid by the heating means.

2. A hot gas reciprocating engine as herein described and illustrated in the annexed drawings.

MARKS & CLERK.

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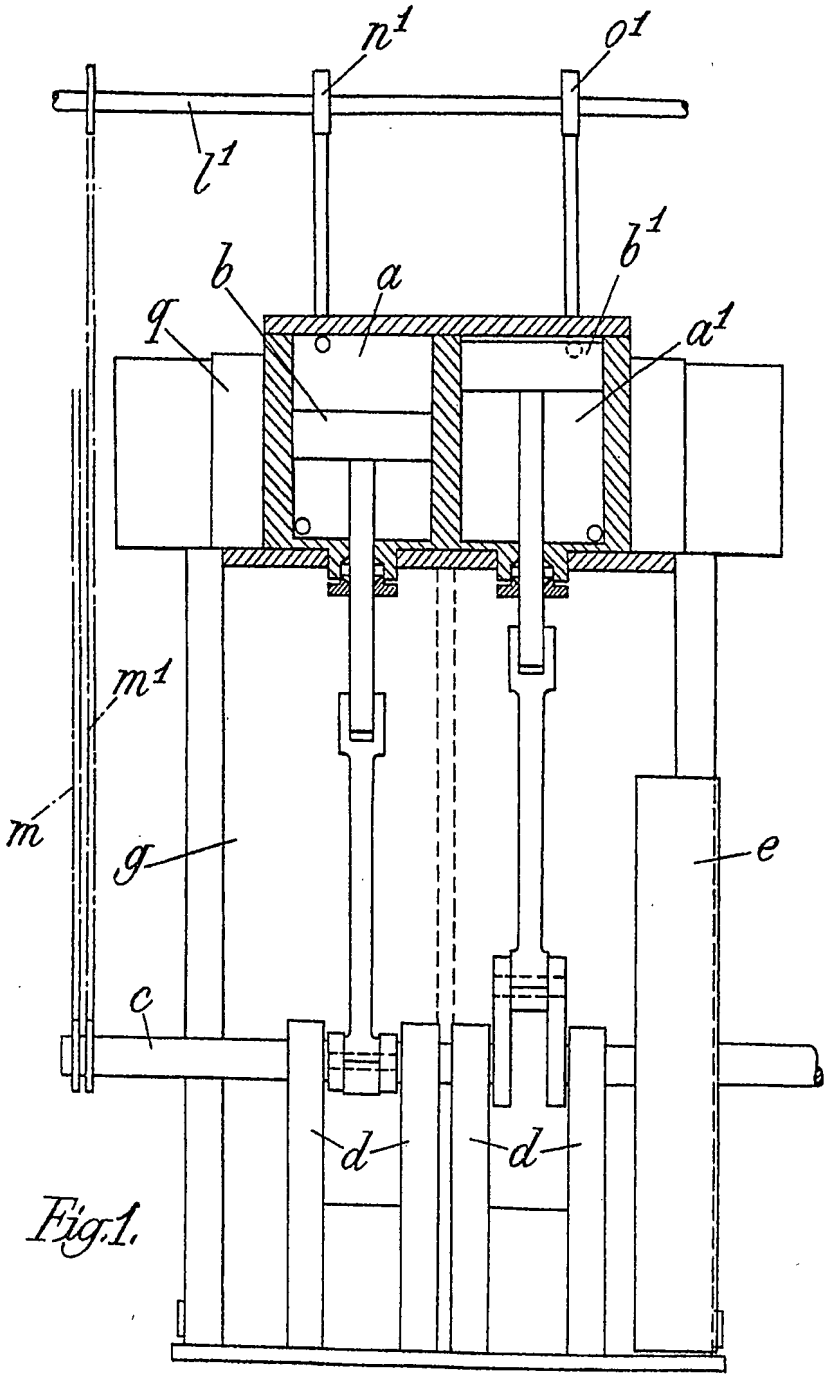

Fig.1.

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SHEETS 1 & 3

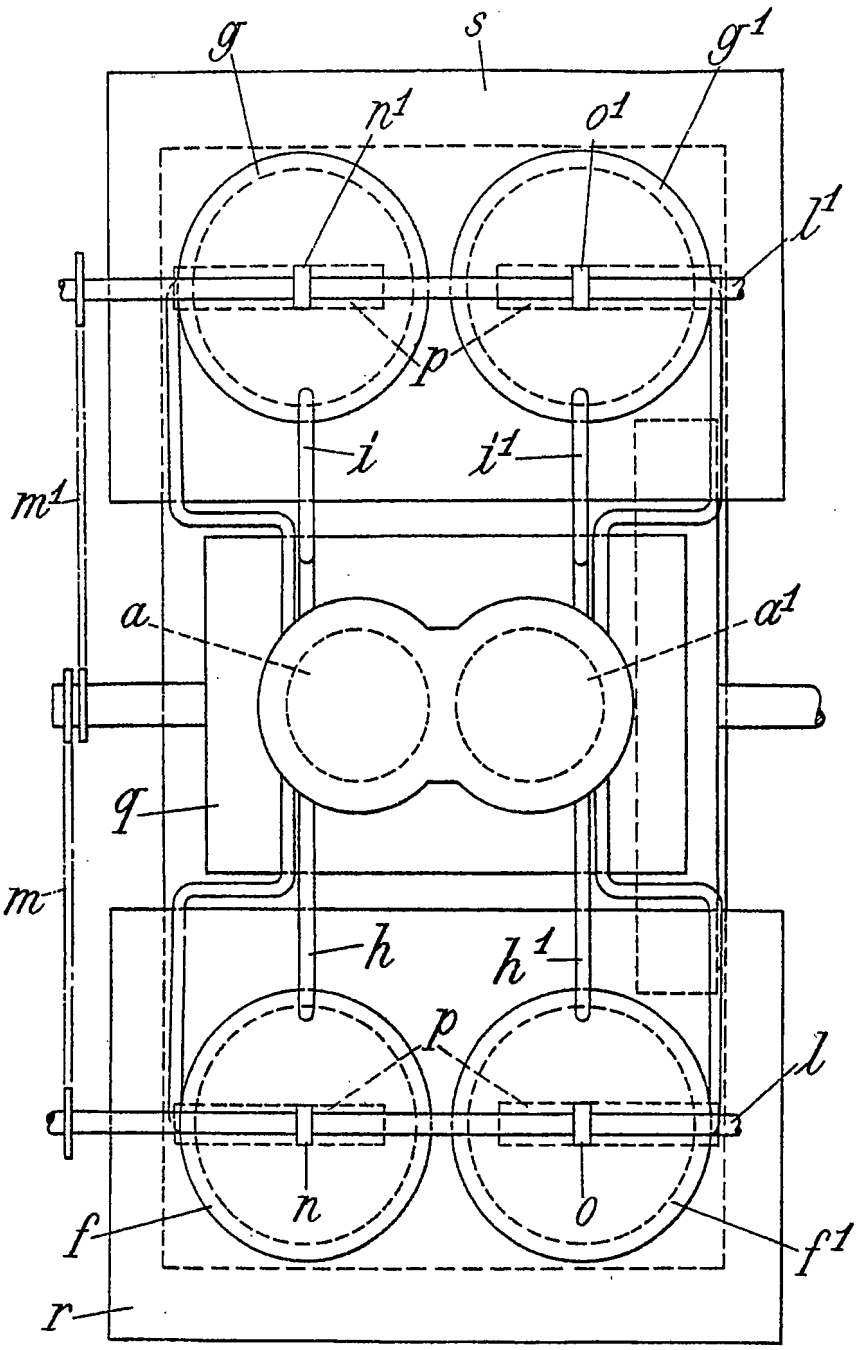

Fig. 3.

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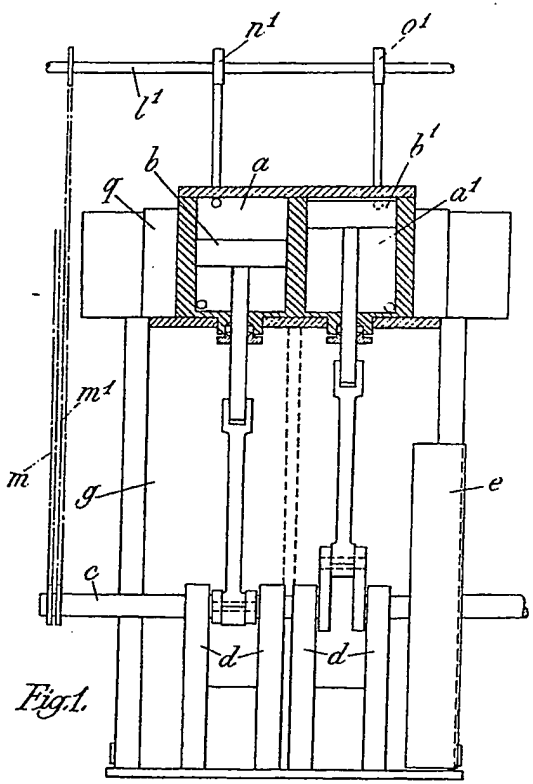

Fig.1.

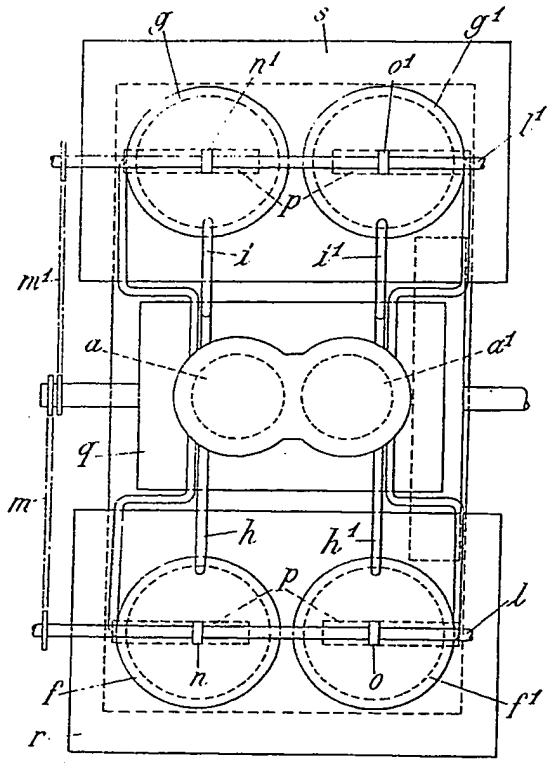

Fig.3.

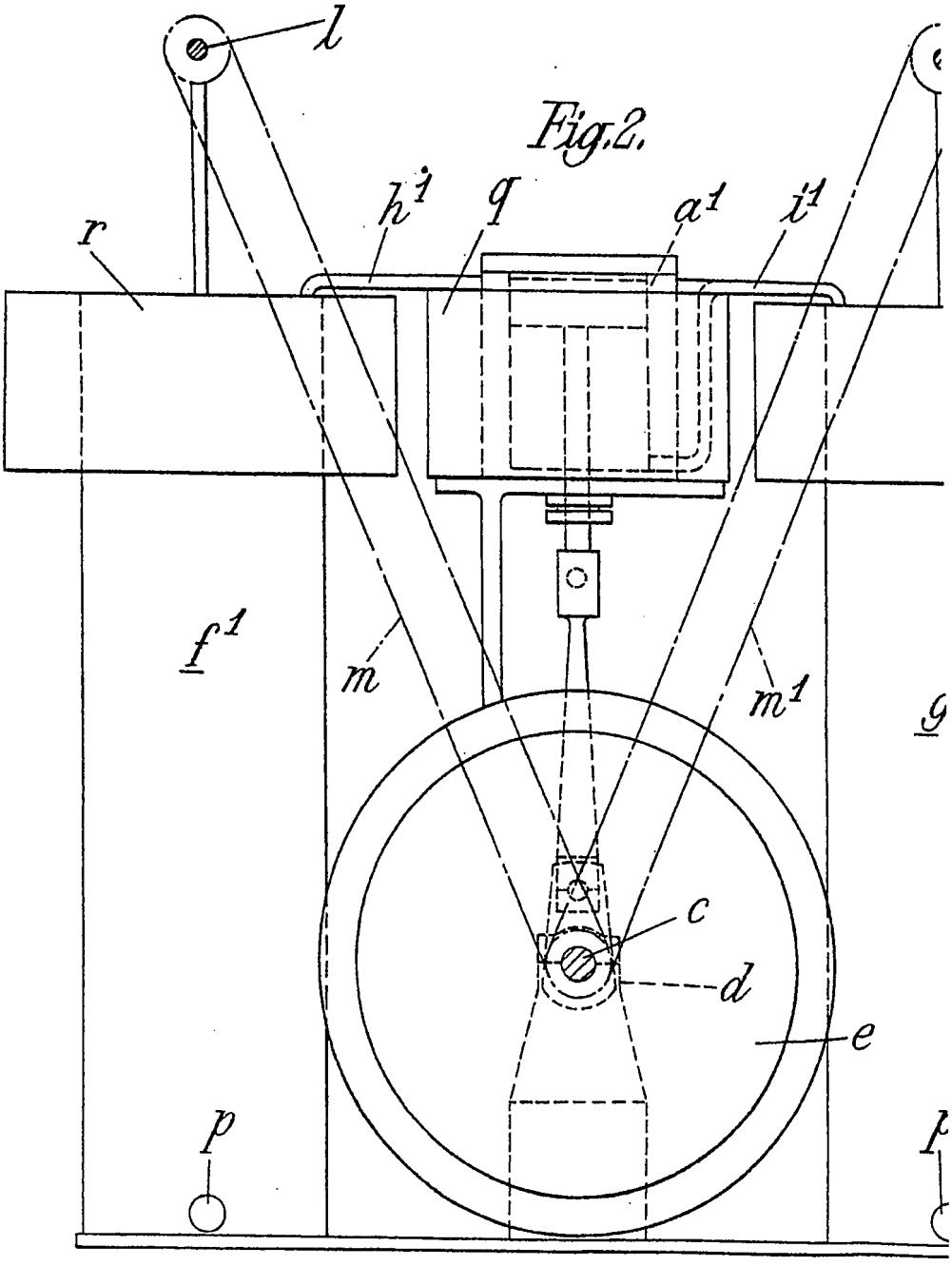

Fig.2.

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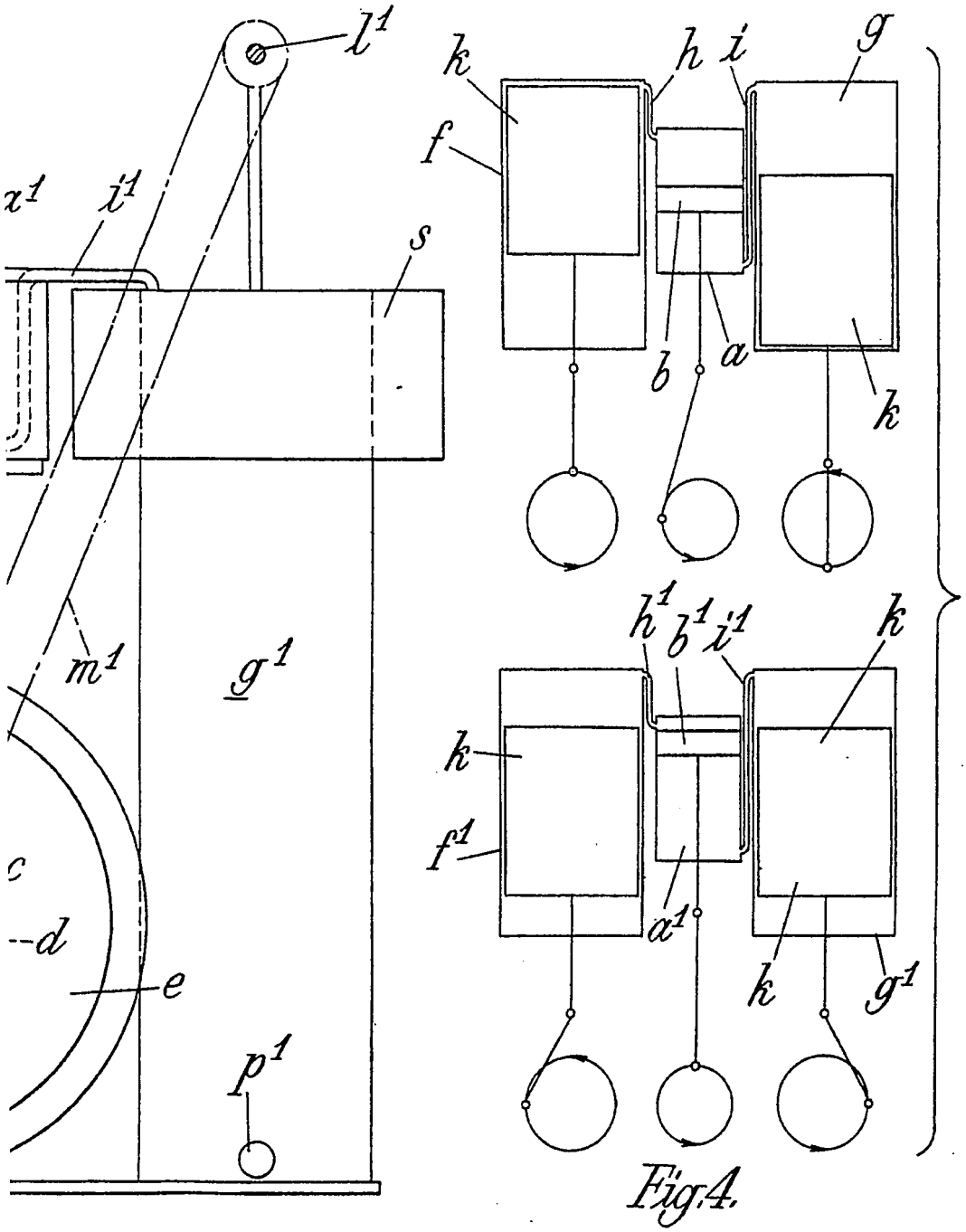

Fig.4.

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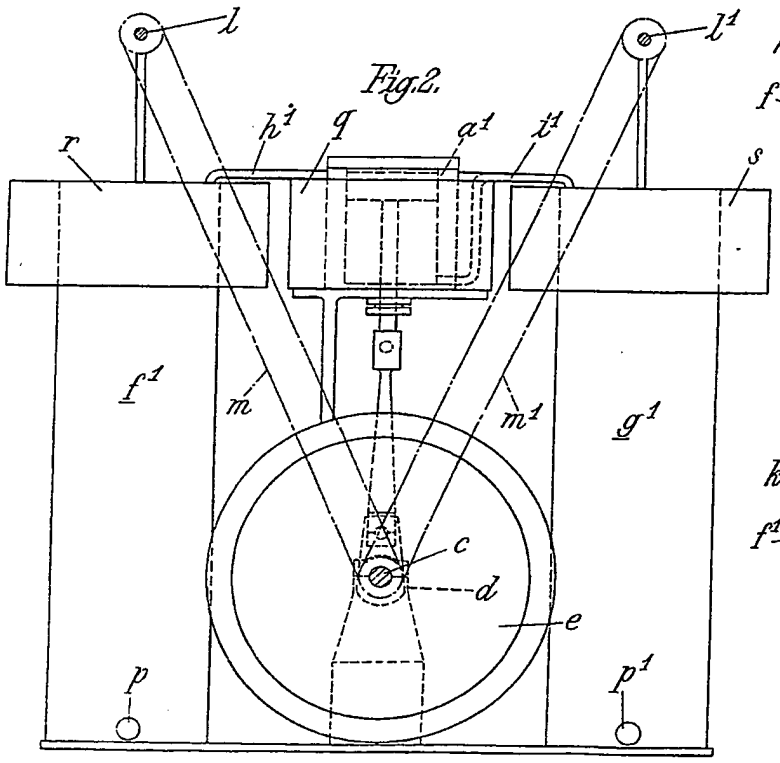
SHEET 2

Fig.2.



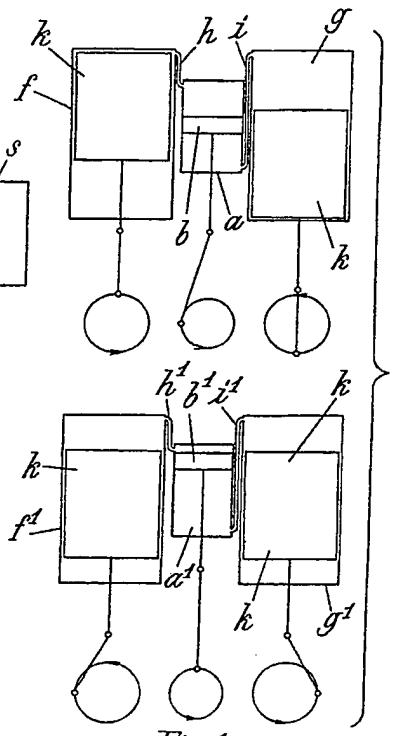


Fig.4.